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Helen Thompson Gaige

by ALEXANDER G. RUTHVEN
University of Michigan

Systematic zoologists interested in the history of the general field are well aware of the remarkable advances in herpetology which have been made in recent years. Prior to the turn of the century, highly important work was being done by Boulenger, Cope, Stejneger, and others, but the investigators were few in number and their interest was usually divided between reptiles and amphibians and other groups.

The period since 1900 has witnessed the development of a large number of herpetologists and an enormous increase in publications on the habits, distribution, and systematic relationships of the cold-blooded vertebrates above the fishes. In the United States herpetological studies have extended beyond the large museums, and the universities and colleges have both fostered investigations in this field and deliberately undertaken the training of specialists.

When the history of the zoology of amphibians and reptiles is written, the name of Helen Thompson Gaige will be given an important place in the roster of scholars who are responsible for the recent kindling of interest in these groups. Her careful work and sound judgment are well known but of even more importance has been her breadth of interest in the subject. Realizing the importance of scientific collecting, cooperation among students, and proper preservation of material, and with a total lack of professional jealousy, which has all too often interfered with the progress of science, she has not only contributed directly to knowledge of the subject but has had a prominent part in improving techniques, in promoting the work of others, and in developing an *esprit de corps* among investigators. All in all, for her contributions, both direct and indirect, the profession is and will remain deeply in debt to Mrs. Gaige.

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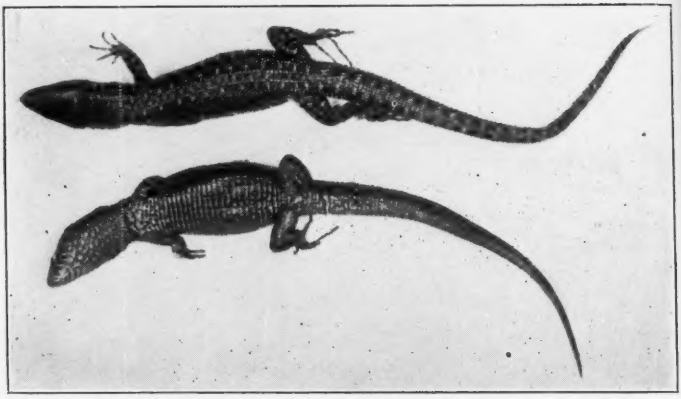
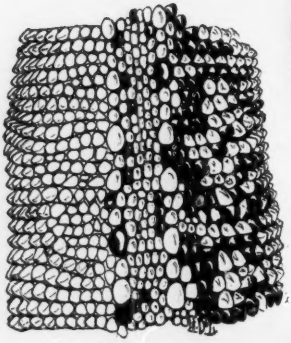
HELEN THOMPSON GAIGE

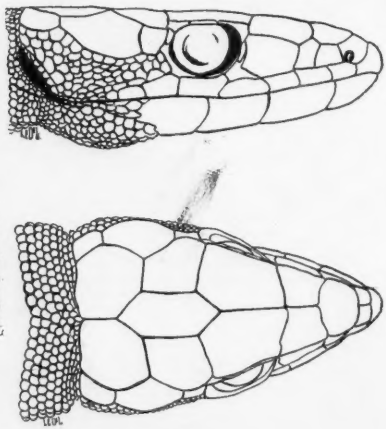
PLATE II



Dorsal view of type; ventral of a paratype



Lepidosis of dorsal surface



Lateral and dorsal views of head

LEPIDOPHYMA GAIGEAE, sp. nov.

Museum
Zoology
Taylor
1-9-37
92576

LIST OF SPECIES NAMED BY HELEN T. GAIGE

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Hyla parkeri Gaige
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A New Xantusiid Lizard of the Genus Lepidophyma

by WALTER MOSAUER
University of California at Los Angeles

During a recent herpetological expedition through Mexico, the writer collected a series of lizards in the mountains of Hidalgo. Among them were one dozen specimens of a xantusiid, which were at once suspected to belong to a still undescribed species, since they differed sharply from specimens of *Lepidophyma flavomaculatum*, which had been collected earlier on the trip. This suspicion was confirmed when Bocourt's and Boulenger's descriptions were consulted.

LEPIDOPHYMA GAIGEAE, sp. nov.

Type:—Number 971, Mosauer Mexican Collection, an adult collected September 1, 1935, at Durango, State of Hidalgo, Mexico, by Walter Mosauer.

Paratypes:—Mosauer Mexican Collection 972-983, with the same data as the type.

Diagnosis:—A typical *Lepidophyma* with greatly flattened head and body, fused, transparent eyelids, and much reduced cranial scutes, no supraoculars, no median prefrontal, only one well developed postocular. Dorsal scales heterogeneous, but less so than in *L. flavomaculatum;* no very small granules as in the latter, but rather large beads and tubercles grading in shape from slightly convex circular and elliptical scales to pyramidal, pointed tubercles. Color black or very dark grey with grey markings. A saxicolous lizard from the oak and pine belt of the mountains.

Description:—Head large, almost one-third as long as the distance from occiput to base of tail, triangular in outline, snout pointed, temples somewhat swollen. Head greatly depressed, pileus almost perfectly flat, covered with large plane scales of greatly simplified arrangement. Rostral small, pentagonal; nostril pierced between anterior nasal, second upper labial, and posterior nasal; the latter in contact with the large frontonasal which also touches the anterior nasals, the anterior loreal, and the pair of large prefrontals which form a median suture; no middle prefrontal; no supraoculars; the pentagonal posterior frontals adjoining the orbits laterally, the hexagonal interparietal and the large frontparietals posteriorly. Very large parietals, forming a median suture, and touching laterally the very large anterior temporal and the small posterior temporal; the prefrontal touching the anterior loreal, which is higher than wide, and the larger posterior loreal. Eye without movable lids, pupil vertical. A narrow ring of ill-defined scales surrounds the eye composed of the following: a lower preocular of peculiar shape, with its lower, square part wedged between fourth and fifth upper labial, its upper, vertical part, very narrow, separating the second loreal from the tiny upper preocular which touches the first supraciliary above; three or four very narrow, ill-defined supraciliaries; and three or four somewhat larger scales around the posterior circumference of the orbit, followed by one postorbital, which is in contact with the frontoparietal and the anterior temporal. Ear opening large, oblong, slanting forward and downward, the anterior edge guarded by seven tubercles. Below the postocular and above the upper labials, the conical small scales of the temples reach the orbital ring of scales. Seven upper labials, fifth largest and entering orbit. Mental large; three pairs of large labials, the anterior pair forming a median suture. Throat covered with convex, ovoid scales; a transverse gular fold, followed by three to four rows of small transversely elongated scales, which are rather definitely set off from the large, flat, polygonal scutes of the anterior thoracic region. Body elongate, depressed, covered with circular to ovoid scales which vary in convexity from flat relief to strongly pointed, conical or pyramidal shapes. A mid-dorsal band, four to five scales in width, of small, ovoid, only slightly convex scales, is bounded on either side by a single row of slightly convex, teardrop-shaped scales about two to five times as large as the mid-dorsal scales; lateral to this row of scales, others, smaller in size, but more strongly convex, grade into the large pyramidal scales of the flanks. The middorsal band, and its bounding rows of large scales, begins in the scapular region and extends, increasingly distinct, to the base of the tail. The ventral surface is covered by large, smooth, rectangular scales, arranged in ten longitudinal and thirty-three transverse series (counting the smaller and irregular anterior thoracic scales, but not counting the two pairs of enlarged preanal scales). Nineteen femoral pores on the left, eighteen on the right. Extremities well developed, covered

with pyramidal or trihedral scales. Tail rather thick, somewhat quadrangular in cross section, longer than head and body, and covered with rings of half cylindrical scales, rectangular in outline.

The pileus of the head is uniformly dark brown. The body, tail, and extremities are very dark grey to black, marked with light grey or whitish bands and spots. The mid-dorsal band is almost pure light grey in some specimens, marked with dark and light crossbands in others; the rows of large scales bounding the mid-dorsal band are almost without exception whitish; lateral to these, whitish crossbands, two scale rows in width, are spaced at intervals of five to six transverse rows of black scales; the sides of the body and neck are dotted with pure white scales, scattered irregularly, or occasionally arranged in transverse rows, among the black scales. The same pattern prevails on the extremities; the tail is mottled light and dark grey; the throat is whitish, reticulated with dark grey; the ventral scales of the body are white, with blackish anterior edges; the tail is whitish, suffused with grey, on its ventral surface. The upper labials are black, with whitish edges; the lower labials show blackish quadrangles, sometimes incomplete, which parallel their edges—or one might say, they are blackish with white centers and edges.

	Snout to vent	Snout to ear	Width of head	Tail	Fore limb	Hind limb
Type	59.5	14.5	10	80	19	28.5
Largest paratype	6.3	14.5	10	broken	19	29

Habits and Habitat:—All the specimens were collected in the rock fissures, and between loose rocks, of a "pedregal" at Durango. This tiny settlement is located in the pine, oak and walnut belt of the mountains of Hidalgo, at an altitude of 2200 m, 27 km south of Jacala, Hidalgo. The only previously known species of *Lepidophyma, L. flavomaculatum,* occurs, according to Sumichrast, only in the "tierra caliente," the tropical lowlands of Mexico, where it lives in old decaying logs and crevices of dead trees, more rarely under rocks. I collected several juvenile specimens of *L. flavomaculatum* in a decaying log in the tropical forest near Tamazunchale, Tamaulipas, which is north of Durango, but much lower in altitude. L. *gaigeae* shares the cracks of the rocks which it inhabits with three species of *Sceloporus,* e. g. S. *torquatus,* S. *microlepidotus,* and a third, as yet undescribed species, close to S. *jarrovii,* of which the male is brilliantly blue on the entire dorsal surface as well as on the flanks and abdomen.

The movements of L. *gaigeae* are quite agile, so that it is not always easy to capture a specimen after it has been uncovered by turning over a loose rock. Like *Xantusia henshawi* and *Sceloporus torquatus,* this lizard prefers the cracks between the rocks to the spaces between rock and soil; no specimens were found under rocks which rested directly on the ground. The extremely flat head and depressed body are obvious adaptations to a life in narrow crevices.

Contents of the digestive tract consisted of the chitinous fragments of arthropods, such as moths.

Description of a New Sceloporus from Southern Mexico

by HOBART M. SMITH
Department of Zoology, University of Kansas

*Among the specimens collected by Dr. Edward H. Taylor and myself in Mexico during the summer of 1935 are several which represent a very distinct species of *Sceloporus*, of the *spinosus* group, which may be called

SCELOPORUS EDWARDTAYLORI, sp. nov.

Type:—Male, no. 4221, collected near Ixtepec (San Geronimo), Oaxaca, August 22, 1935. *Paratypes*: Twenty-two, including two (nos. 4222, 4228) collected with the type, and twenty (nos. 3919, 3920, 4003-4007, 4044, 4094-4105) from near Totolapam, Oaxaca, August 7, 1935. All collected by Edward H. Taylor and Hobart M. Smith.

Diagnosis:—A moderately large species (103 mm. maximum snout to vent measurement), belonging to the *spinosus* group; dorsal scales in parallel series, 28 to 32 from occiput to base of tail, weakly keeled, strongly mucronate, much larger than laterals (about twice), which are somewhat larger than ventrals; supraoculars very large, the fourth always in contact with median head scales, the third rarely not; series of scales between supraoculars and superciliaries entirely absent or represented by an incomplete series of not over four very small scales; femoral pores 10 to 13; tibia about equal to length of shielded part of head, usually slightly longer; length of the fourth toe somewhat greater than length of head from snout to posterior border of ear; lamellar formula for fourth toe 17 to 19; color above generally gray, with irregular dark markings; ventral surfaces practically immaculate except in young; males without distinctive ventral coloration.

Description of Type:—Head quite thick and broad; parietals single, about one-third as large as interparietal; frontoparietals single, separated medially by contact of frontal and interparietal; posterior section of frontal about one-third as large as anterior; anterior section abnormally divided; prefrontals single, widely separated by contact of median frontonasal and frontal; lateral frontonasals in contact with canthals; two canthals, both small; a very small subnasal; enlarged supraoculars four on each side, extremely large, partly separated from median scales by an incomplete row of small scales beginning at first superciliary and passing posteriorly to about the middle of the third supraocular, the scales becoming gradually smaller posteriorly; a small scale at posterior edge of last supraocular; two very small scales separating supraoculars and superciliaries; posterior superciliary very large, prominent; loreal present; preocular present, in contact with series of scales above supralabi-

* I wish to acknowledge my indebtedness to Dr. Edward H. Taylor for his assistance in many respects. The study of Sceloporus has been forwarded through the aid of a grant from the University of Kansas Graduate Research Fund.

als; latter series double below supraocular, reduced to one anteriorly below loreal, the single row continuous around snout.

First pair of postmentals in contact, second pair separated; four supralabials to a point below middle of eye, and five infralabials to the same point; inner row of the two rows of scales intercalated between postmentals and infralabials narrowly separated from mental; latter with a labial border about two-thirds as great as that of rostral.

Three scales on anterior margin of ear, upper two larger, extending across tympanum, rounded; lower lobule acuminate, denticulate; lateral nuchal fold with large scales on anterior border, concealing fold; dorsal scales large, as broad as long or broader, 30 from interparietal to base of tail; dorsals weakly keeled, strongly mucronate, with three to five lateral mucrones; lateral scales as dorsals, except about one-half as large as dorsals; ventrals somewhat smaller than laterals, with one or two prominent notches.

Dorsal scales of upper foreleg somewhat smaller than lateral body scales, becoming smaller toward digits, all weakly keeled, mucronate and denticulate; ventral scales of forelimb averaging somewhat smaller than dorsal scales of same member, smooth, notched; axillary scales very small; lamellar formula for fingers 5-10-14-15-9.

Dorsal scales of hind leg as dorsals on body, but somewhat smaller than lateral body scales, those on tibia and femur subequal in size; ventral scales on hind leg somewhat smaller than dorsals, smooth, notched, those on foot smaller and keeled; scales on posterior surface smaller than preanals, keeled; femoral pores 11-11; lamellar formula for toes 6-11-15-17-12; dorsal caudals somewhat smaller than dorsals on body.

General color olive-gray, a few scales on back with a basal, indistinct light blue area; keels black; a broad, very indistinct slate colored band from eye above ear to dorsal margin of insertion of hind leg; this band is narrow until it reaches the forelimb, passing posteriorly; below lateral dark band is a light band, also indistinct, somewhat narrower, passing from upper labial region through ear onto shoulder and to groin; below this a narrow area of slate, very distinct as a black spot in front of foreleg, elsewhere very indistinct; limbs more or less uniform, splashed irregularly with slate. Ventral surfaces immaculate, with a suffusion of light pearl blue (Ridgway) in the lateral abdominal areas and throat region. Tail dimly banded; a light, dark-edged spot surrounding pineal gland.

Measurements:—Snout to vent, 101 mm.; snout to occiput, 18.5 mm.; snout to ear, 22.5 mm.; hind leg, 66 mm.; fourth toe, 24.6 mm.; fifth toe, 13.7 mm.; tibia, 18.9 mm.; scales to head length, 5.5; tail, 156 mm.; ventral scales (gular region to anus), 41; scales around middle of body, 33.

Remarks:—In females, and always in the young, narrow, slate-colored, undulate, transverse bands about five in number are present

on the back; they are variable in distinctness in adults, occasionally quite indistinguishable. In the young the tail is distinctly banded. In some females and in all young some fine, irregular dark lines are present on the throat, occasionally forming two parallel longitudinal lines near the middle of the throat.

Variation in scalation and proportions are minor, and will be discussed elsewhere.

The specimens were collected in semi-arid localities, frequenting mesquite trees, large-stemmed yuccas and the forms of *Opuntia* which reach large size.

The species apparently is most closely related to *melanorhinus*, but differs from this and others of the *spinosus* group in numerous characters.

Seventeen-Year Locust in the Diet of the Snapping Turtle

by NEIL D. RICHMOND

West Virginia Biological Survey, Morgantown, W. Va.

On July 5, a snapping turtle, *Chelydra serpentina* (L), taken from the Greenbrier River near Talcott, Summers County, West Virginia, was dissected and an examination of the viscera revealed a fact of interest. The entire colon was found to be distended by a mass of indigestible remains of seventeen-year locust, *Magicicada septendecim* (L.). The only other materials present in the colon were the claws of a crayfish, three snails, and a small amount of undigested vegetable matter. The small intestine was empty; the stomach contained one crayfish.

The turtle was a medium size specimen with a shell length of nine inches.

During the summer of 1935, a large brood of cicadas appeared in Summers County and in other parts of southern West Virginia. Large numbers of these insects were observed in the shallow margin of the stream, usually clinging to leaves and floating debris. This would account for the undigested leaves present with the cicadas. Evidence that the snapping turtle will include cicadas in his diet may have little significance; but the observation contributes an interesting item to our knowledge of the ecology of this animal.

Lizard Digestion Studies

by GEORGE F. KNOWLTON
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Laboratory studies of the rate of digestion, as indicated by adult and nymphal beet leafhoppers, *Eutettix tenellus*, being digested beyond the point of recognition when examined under a binocular microscope, were conducted with the two small lizards, *Uta stansburiana stansburiana* and *Sceloporus graciosus graciosus*. Freshly killed beet leafhoppers were placed in the mouth of each lizard, which was then observed for a short time until the insects had been swallowed. In no case were specimens regurgitated, and only when large numbers of leafhoppers were placed in a lizard's mouth at one time would a specimen be dropped as the lizard opened its mouth while gulping to swallow its food.

Uta stansburiana stansburiana (Baird and Girard). — Digestion studies with this common predator of the beet leafhopper (Table 1) indicated that approximately 78 per cent of the nymphal leafhoppers were digested beyond recognition in six hours and 98 per cent digested within 12 hours, none being recognizable at or beyond 18 hours. Thus, under field conditions, few nymphs ingested during the morning feeding period would be recognizable in lizards taken during late afternoon. Adult *E. tenellus* as a rule were digested more slowly than nymphs, although approximately 80 per cent of those ingested were digested beyond recognition within 12 hours, and only about 8 to 5 per cent remained in recognizable condition after digestion had progressed for from 24 to 48 hours, respectively.

Table 1. A study of the time required to digest *Eutettix tenellus* beyond recognition in stomachs of *Uta stansburiana stansburiana*

No. Hours	No. Lizards	No. E. tenellus Ingested		No. E. tenellus recognizable			
		Adults	Nymphs	Adults	(%)	Nymphs	(%)
6	12	85	46	56	65.88	10	21.74
12	12	105	65	20	19.05	1	1.54
18	12	118	103	26	22.03	0	0.00
24	11	85	85	7	8.23	0	0.00
30	11	90	70	6	6.66	0	0.00
36	11	85	75	5	5.88	0	0.00
42	10	85	65	7	8.23	0	0.00
48	13	105	65	6	5.71	0	0.00
TOTALS	92	758	574	133		11	

Sceloporus graciosus graciosus (Baird and Girard)—Tests conducted with a smaller number of lizards indicated that the sagebrush swift (Table 2) digested *E. tenellus* adults at about the same rate as the brown-shouldered Uta. One *Sceloporus* exceeded this rate, however, digesting 20 of the 22 specimens beyond recognition in 15

hours. A second series of digestion tests was undertaken to see how rapidly *E. tenellus* digested after becoming partially dry. Specimens killed the day previously and stored in a 2-ounce tin ointment jar for about 20 hours were fed to 10 sagebrush swifts; digestion was much slower in this case (starred, Table 2) than in instances where freshly killed specimens were used.

Table 2. Time required to digest *E. tenellus* adults beyond recognition in stomachs of *Sceloporus graciosus graciosus*

No. Hours	No. Lizards	No. E. tenellus Ingested	No. E. tenellus Recognizable	Percentage Still Recognizable
6	2	30	18	60.00
12	4	74	16	21.62
15	1	22	2	9.09
18	2	30	6	20.00
TOTAL	9	176	51	
10	1	40*	31	77.50
15	1	40*	37	92.50
18	1	35*	25	71.42
20	1	40*	25	62.50
30	2	20*	9	45.00
42	4	65*	30	46.15
TOTAL	10	240	157	

In a number of instances lizards were kept unfed for two or three days after being captured in the field; they were then fed beet leafhoppers. In many such cases heads of ants, wing covers and body parts of weevils and other hard beetles were present in the stomach in an easily recognizable condition.

Caterpillar larvae were frequently recognizable in stomachs two and three days after ingestion; in such cases usually the head and body wall were in reasonably good condition, but most of the body contents appeared to have been digested away. Apparently hard-bodied insects require a much longer time for digestion in the stomach of a lizard than do soft, fragile insects

Studies upon digestion indicated that practically all nymphs of *E. tenellus* are digested by lizards within 12 hours and 90 per cent of the adults within 18 hours in the laboratory, with a mean day temperature of approximately 72° F. and with night temperatures dropping to 65° and 60° F. During much of the summer, diurnal temperatures in the field are much higher and digestion probably hastened. With nights usually cool, digestion might be slowed down. However, in general, it is my belief that the results obtained in the laboratory would be near the average rate of digestion of these two species of lizards under field conditions from mid-June until late September.

New York the Type Locality of Rana pipiens Schreber

by CARL F. KAUFFELD
American Museum of Natural History

The type locality of the leopard frog, *Rana pipiens*, has been a matter of some dispute. Stejneger and Barbour in the first two editions (1917, 1923) of the North American Check List have stated the type locality to be Pennsylvania. Kellogg (1932, p. 205) believed Schreber's description of *Rana pipiens* to have been based on specimens collected by Kalm. Hence the type would be from "Raccoon, Gloucester County, New Jersey" (probably what is now Bridgeport on Raccoon Creek). As a result this appears as the type locality of *pipiens* in the 1933 edition of the North American Check List.

Such a conclusion would threaten great confusion since the south Jersey leopard frogs *are not* what is generally understood to be *pipiens*. Wright has twice (1932, p. 419; 1933, p. 186) referred to the peculiarity of these southern New Jersey specimens and finally decided that they are *Rana sphenocephala* rather than *pipiens*, in which case *sphenocephala* would have to be called *pipiens*. No doubt Wright is correct in considering these frogs *sphenocephala* although it is possible that a form distinct from either *pipiens* or *sphenocephala* inhabits southeastern Pennsylvania, southern New Jersey, Delaware, and Maryland. In either case a new name would have to be supplied for *pipiens* elsewhere.

However, it is at once apparent from the following literal translation of the opening paragraphs of the original description (p. 185-186) of *pipiens*, that Schreber's specimens were not from New Jersey but from New York:

"The native country of this frog is North America. Catesby probably observed and drew it in Carolina; Kalm found it in New Jersey, and Doctor Schöpf, field-medico to the Royal Brandenburg troops in America, whom we have to thank for the welcome acquisition of a specimen of this species of frog as well as other rarer natural objects, found it *in New York*. It has its abode in ditches and streams, preferring clear, flowing water.

"The length of the whole frog, *as the above-mentioned example which I have before me shows*, and as a written account from the doctor agrees, equals from the point of the mouth to the extremity of the outstretched feet, 5 to 6 English inches." (The italics are mine.)

KELLOG, 1932, U. S. Nat. Mus. Bull. 160
SCHREBER, 1782, Der Naturforscher, Halle, vol. 18 pl. 4.
STEJNEGER AND BARBOUR, 1917, 1923, 1933
Check List of North American Amphibians and Reptiles. 1st, 2nd, and 3rd editions. Harvard University Press, Cambridge, Mass.
WRIGHT, 1932, North American Salientia (Anura) No. 2, MacMillan Co., New York.
1933, Handbook of Frogs and Toads. Comstock. Pub Co., Ithaca, N. Y.

The Terminology of Reptilian Musculature

by D. DWIGHT DAVIS
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Thirty-five years ago the formal adoption of the International Rules of Zoological Nomenclature foreshadowed the end of an era of chaos in taxonomic terminology. Almost half-a-century has passed since the BNA, virtually by decree, unified the naming of the parts of the human body. Yet today in the field of Comparative Anatomy —one of the oldest of the biological sciences—anatomical nomenclature is still wholly a matter of personal caprice. This humiliating state of affairs is a source of continual annoyance to anatomists, particularly those who must deal in any way with the muscular system. Not a few ambitious myological studies are prefaced by the plaint, all too well-founded, that the difficult labors of drawing up synonymies have exceeded those demanded by the anatomical investigation itself. To that far larger group for whom anatomy serves the important function of tool or foundation for work in other fields, the situation must frequently become almost intolerable, and at all times impede progress in any branch of zoology based upon anatomy.

Among the anatomical systems the muscular system has, for obvious reasons, suffered most from an excess of names, and among vertebrate groups the Reptilia show by far the greatest confusion in the naming of muscles. Several factors have combined to produce this result. Probably the most important is the lack of a complete descriptive anatomy of any reptile, comparable to Gaupp, Ecker and Wiedersheim's monumental work on the frog and Francis' more recent account of the salamander. The stabilizing influence that "Die Anatomie des Frosches" has had on myological terminology in amphibians cannot be overestimated. It has long served as a sort of "unofficial BNA" for salientians. Somewhat less important from the practical standpoint, though far more so in the end, is the fact that the Reptilia are open to attack on both flanks. Whether homology is attempted from the Amphibia up (the musculature of fish is so generalized as to be useless in detailed work), or from man down, the reptiles represent the crucial transition stage from one Class to another. In addition, some of the most extreme cases of vertebrate specialization known are to be found within the reptiles themselves. The cranial and axial musculature of snakes is modified and fragmented to an extraordinary degree. Lizards supply many cases of reduced or wholly absent limbs, with corresponding modification of the limb musculature. The extreme and unique specialization of turtles has profoundly affected almost their entire muscular system. Finally, when it is considered that the Class Reptilia embraces the surviving end-forms of several extremely old groups, like *Sphenodon*, the Crocodilia, and the Testudinata, it becomes apparent that

disagreement over the designation of muscles in members of this group is by no means without justification.

The history of reptilian muscle terminology falls naturally into two successive schools of thought, *with the work of Max Fürbringer standing at the turning point. In the pre-Furbringer era, the pioneers in England and Germany who were making the first adequate dissections of reptilian muscles were content to follow the convenient lead of human anatomy—then, as now, towering over comparative anatomy on a self-sufficient plane of exact and minute knowledge of the human body. The whole vocabulary of human myology was embraced without question, and homologies with amphibian and reptilian muscles were drawn in a most convenient, but highly arbitrary, way. Unfortunately the classic studies of Stannius, Mivart, Sanders, and others are marred by this disagreeable defect. Then in 1870 Furbringer promulgated the curiously short-sighted theory that the proper name for a muscle is one compounded from the names of its various points of origin and insertion, at the same time proposing an entirely new series of names for reptilian girdle and limb muscles, based on this thesis. **Fürbringer's proposal came at a time when students of myology were convinced that uncritical identification of the muscles of the lower vertebrates with those of man was leading nowhere, so that they flocked to his banner. Almost overnight a revolution in myological terminology took place. Hans Gadow in particular promoted general acceptance of this thesis.

The illusion that Fürbringer's rule was the key to a simplified system of myological terminology was destined to be short-lived. Comprehensive studies of single muscle systems, when carried through the vertebrate series from amphibians to mammals, soon revealed that many muscles, unquestionably identical on every other basis of homology, would have to bear different names because of relatively slight variations in their attachments to the skeleton. The effect of the complete divorce from uncritical application of human terminology had been too wholesome to be dropped, however, and the general reaction was one of compromise. The most flagrant violations of obvious homology were relieved by resorting to more general names, but the validity of Fübringer's rule was generally accepted.

Fürbringer's proposal, now considerably more than a half-a-century old, was the last important step in the direction of a general revision of myological terminology. Gaupp, in the later edition of Ecker's "Anatomie des Frosches," revised the original myological

*Gadow recognizes two significant earlier stages in myological terminology—an initial stage of naming muscles from their general shapes, or their superficial resemblances to well known objects (as **gluteus, deltoideus, pyriformis**), and a later stage of naming according to function (**levator scapulae, depressor mandibulae**). Relicts of both of these systems survive in human anatomy.

**This principle did not, of course, originate with Fürbringer, although its general acceptance dates from his work.

nomenclature to conform to this concept. As was pointed out above, this exhaustive work, through its very prestige, has largely determined the names used in subsequent studies on the frog. On the other hand, recent students of mammalian anatomy have usually employed BNA terminology, since the identification of most mammalian muscles with those of man is simple. The reptiles are thus again left midway between two completely divergent views, and once more the tables of synonymy reflect the resulting confusion and uncertainty.

Since Fürbringer's principle is still widely employed in work on the lower vertebrates, a critical evaluation of the actual and potential results of its use may be profitable. By far the most serious objection to such a thesis is the fact that, if employed consistently, it ignores completely the claims of comparative anatomy. The muscular system, along with the rest of the animal body, has had a phylogenetic history. Its history has been a particularly erratic one, from both the functional and the morphological standpoints. In spite of this plasticity, however, many muscles may be followed with confidence throughout the vertebrate series, and under the influence of careful comparative work the list is gradually increasing. Failure to recognize this identity in structure through identity in terminology can lead only to further confusion. Likewise, a flood of new synonyms has been loosed, which sooner or later will add their burden to the already heavily laden literature. Furthermore, rigid application of this rule produces philogical monstrosities that have nothing whatever to recommend them. Terms like *M. epicondylo-fibulo-tibio-digitalis ventralis prefundus* (Fürbringer) and *M. femoro-tibiali-tarsum-metatarsum V* (Hoffman) were seriously introduced but are so absurd that they were rejected at once.* As a matter of fact, many names that have been widely accepted, like *M. pubo-ischio-femoralis externus* and *M. caudali-pubo-ischio-tibialis*, are needlessly long and complex, and could well be supplanted by others that are shorter and equally descriptive. Indeed, in the final analysis, about the only legitimate claim to continued perpetuation of Fürbringer's rule is that names so formed do have a certain mnemonic value, since the topography of the skeleton is comparatively familiar. But surely the price of mere memory-aid is exhorbitant when all other considerations must be sacrificed to it.

If, then, the practice of indiscriminately deriving muscle names purely from their points of origin and insertion is to be discouraged, what procedure is to be adopted in practical work? Here several distinct, but equally important, needs must be recognized: those of the student who finds it necessary to employ descriptive anatomy as a background for other work; those of the purely descriptive anatomist, who is making a detailed study of a single form, and for whom names are merely convenient memory-signs; and finally those of the student of comparative myology, who must, perforce, consider

* I am endebted to Gadow for unearthing these gems.

the muscular system as a more or less plastic structure, gradually changing from a simple, primitive system of axial myotomes into the highly differentiated muscular system of the higher vertebrates, but always bound together by the thread of phylogenetic continuity.

A little reflection will reveal that two situations, quite different in their viewpoints, are intermingled here. On the one hand is the *immediate* need for some generally recognized system of names for reptilian muscles—an authoritative list that will make a common source of reference available to those who are not primarily interested in myology from the comparative standpoint. The fact that such a system would be highly arbitrary, and would eventually require much revision, does not materially affect the picture. Interest here is solely in supplying a common denominator for studies in which the muscles figure in other than a comparative capacity. It would be, in short, merely a stop-gap, a highly important concession to the legitimate demands of students in other fields for release from a constantly increasing burden of meaningless synonyms. Such a function can be filled only by a complete, accurate, and well-illustrated description of the myology of some unspecialized reptilian type, preferably incorporated into a monographic account of the whole anatomy of the animal. The lack of just such a work as this has frequently been decried by herpetologists and anatomists alike. The various regions of the reptilian muscular system have long since been described, but the scattered nature of these studies defeats the purpose here set forth.

Much more important is the question of the relation of reptilian myological terminology to the terminology of vertebrate myology as a whole. This problem is, of course, temporarily divorced from the foregoing one for purely practical reasons. As has been pointed out in the past, comparison of muscles in one group with those in another is seriously crippled by lack of any fixed principles of homology. While it can scarcely be doubted that these homologies will eventually be established, the process will obviously be a slow one, with many rearrangements and differences of opinion. To attain this goal without making much of the concomitant descriptive literature almost unusable because of the artificial difficulties of unmanageable synonymies is one of the most difficult problems of comparative myology. The usefulness of a descriptive account of the myology of an animal, if properly done, should naturally endure indefinitely. But if increase in the number of types whose muscular anatomy is known is paralleled by a corresponding increase in the number of names under which each structure has been described, actual progress is relatively small. The fact that this phase of the problem is usually given small consideration makes the danger all the more real. When the situation is viewed in its entirety, several important considerations emerge. These may be summarized:

A. The futility of continuing the practice of strict naming from origin and insertion has already been discussed. While it would be

foolish to try to anticipate developments by proposing a new set of rules for the naming of muscles (if, indeed, a satisfactory set could be devised), it seems probable that some system of topographical names, considerably less exact in their implications, will be found most satisfactory. It is noteworthy that such a method has already been largely adopted in the terminology of the cranial and trunk muscles.

B. The error of considering terminology in connection with the study of a single form, or compact group of forms, is obvious, although it has frequently been tried. Such a procedure can result only in further confusion and multiplication of names.

C. With a group as diversified as the Reptilia, it would seem to be a most logical step to begin by homologizing the muscular system within the limits of the Class itself. This would bring an extremely troublesome group under some measure of control, and thus in no small degree clear the way for broader homologies with other more compact groups.

D. In the interests of future generations of myologists, who, if the present rate of multiplication of synonymic terms is continued, will look back with scorn upon their thoughtless predecessors, I offer the following suggestions:

1. Never publish a new name without stating it to be such. This simple act of courtesy has been neglected in a surprising number of instances.

2. A new name should not be proposed without ample reason for rejecting one already in use. Personal caprice is no reason for swelling the synonymy.

3. Naming or renaming of muscles should never be undertaken without careful consideration of the phylogeny of the structure in question.

4. It is well to remember that whether a proposed term gains general acceptance or not, its publication adds another name to the synonymy.

5. Short, simple terms are vastly superior to long hyphenated combinations.

6. In general, a new name is not desirable for what is obviously only a specialized slip of a parent muscle. The addition of a restrictive adjective to the name of the parent muscle is much more satisfactory if any special designation is required.

7. The author should state clearly, at some point in his discussion, the technical name of the muscle in question, in his usage. This permits use of vernacular or translated muscle names in the running text, without still further complicating the synonymy. This corresponds exactly to the use of taxonomic and vernacular names in systematic papers, and contributes to the exactness of reference to synonymy in cases of disagreement.

It is hardly necessary to point out that, at least as far as comparative myology is concerned, the conflict between BNA terminol-

ogy and the more or less established terminology of comparative anatomy will sooner or later have to be settled. This situation is as regrettable as it is unavoidable, since either the bulk of the nomenclature now in use for mammalian anatomy will have to be discarded, with a corresponding decrease in the value of the work that has already been done, or the opposite procedure, with equally serious results, will have to be adopted.

In conclusion, B. G. Wilder's wholesome advice regarding the publication of new anatomical terms may well be repeated: " . . . however necessary and legitimate they seem to the framer, neither a new term nor an old one in a new sense, should be actually published without prolonged consideration, and consultation with at least four individuals representing as many categories of possible critics." An anatomical term, however foolish, inept, or unnecessary, gains a sort of immortality as soon as it is published. It is passed down from synonymy to synonymy in the myological literature. Theoretically it never dies. Apparently this highly important fact is often lost sight of. Careful workmanship would go far toward mitigating the spurious immortality of unnecessary names.

Virginia valeriae valeriae in Pennsylvania

by ROGER CONANT
Zoological Society of Philadelphia.

Mr. Mark Robinson, of Philadelphia, recently presented a specimen of *Virginia valeriae valeriae* Baird and Girard to the Academy of Natural Sciences of Philadelphia (Cat. No. 20605). It was collected during August, 1933, 4 miles northeast of Green Lane, Montgomery County, Pennsylvania beneath a board in a wet meadow.

Since this appears to be the first definite record for this form in Pennsylvania it deserves some comment. The specimen is a female 212 mm. in length, of which the tail occupies 29 mm. There is no evidence of keels and the scale rows are 15 throughout the length of the body. Ventrals are 120, caudals 26, upper labials 6, lower labials 6, oculars 0-2, and temporals 1-1. The color (in alcohol) is uniform dark grey brown above and uniform white below.

Roddy includes *Virginia valeriae* in his "Reptiles of Lancaster County and the State of Pennsylvania" (Publ. Dept. Nat. Hist. Franklin and Marshall College, Sci. Press, Lancaster, Pa., 1928) on the basis of a specimen in the Franklin and Marshall College Museum. This specimen was recently examined by W. Stuart Cramer, of the Zoological Society of Philadelphia, who indentified it as *Storeria dekayi*.

The California King Snake, a Case of Pattern Dimorphism

by L. M. KLAUBER
Zoological Society of San Diego

The status of the California King Snake, *Lampropeltis californiae* (Blainville), 1835, has long been a puzzle to herpetologists. The question has been whether this longitudinally striped snake, so different in pattern from the customary rings of most of the king snakes, is a phase of the Pacific King Snake, *Lampropeltis getulus boylii*, or whether the two are separate species which occasionally hybridize. The problem has now been solved by the hatching of two broods, one from a mother of each form; and each brood contained young of both forms, although in one instance not typical of one pattern. Therefore the two forms are merely pattern phases of a single subspecies which should be known as *Lampropeltis getulus californiae*. However to facilitate discussion I shall continue herein to refer to the phases as *californiae* (striped) and *boylii* (ringed), as if they were separate subspecies.

The arguments in favor of considering the two forms to be pattern phases of the same species have been:

(1) A similarity in size, form, lepidosis, head-markings, and habits.
(2) The presence of a few specimens partaking of the body-patterns characteristic of both forms.

In favor of specific separation have been the following facts:

(1) The sharp distinction in body-pattern between the two forms.
(2) The non-coincidence of their ranges, the ringed phase having a much greater geographical range, and a wider ecological dispersion even near the headquarters of the striped form.

The problem has previously been discussed by Blanchard (1921, p.94), Van Denburgh (1922, p.765), and Klauber (1931, p.36).

The two broods which have been mentioned were hatched by Robt. Hoard of the San Diego Zoological Society, and were the first snakes ever successfully hatched at the San Diego Zoo. The chronology of the two broods was as follows:

BOYLII Mother

July 12	4 eggs laid.
July 13	2 eggs laid.
Aug. 14	Opened an egg which was mouldy; a live embryo disclosed.
Sept. 15	(about) Another egg opened; embryo alive.
Oct. 28	Opened an egg; the embryo was lively and the pattern well colored; a male, **boylii-californiae** intergrade.
Oct. 31	Opened an egg: the young snake was a **californiae**.
Nov. 6	In the morning found one egg hatching; in the afternoon the other was hatching.
Nov. 7	Both snakes emerged; one was a **boylii**, the other an intergrade.

CALIFORNIAE Mother

July 13	7 eggs laid.
Sept. 15	(about) An egg opened; the embryo was alive.
Oct. 18	Opened an egg and found a live embryo showing scales and markings; a male of the **californiae** phase.
Oct. 28	A young snake poked its nose through the shell and came out about an hour later. An intergrade.

Oct. 30 Another snake has poked its head through the shell.
Oct. 31 The snake of yesterday emerged; it was a californiae. Another emerged; it was also a californiae. A third had its head out.
Nov. 1 This snake emerged; it was a boylii except at the tail.
Nov. 2 The last snake emerged; a californiae.

Summarizing the specimens which were allowed to develop to the point where the patterns could be determined we have these data:

BOYLII Mother

1 boylii ♀
1 californiae ♀
2 intergrades ♂ ♂
(Of the intergrades one was almost all californiae, the other almost all boylii)

CALIFORNIAE Mother

4 californiae 2 ♂ ♂ 2 ♀ ♀
2 intergrades ♂ ♂
(Of the intergrades one was mostly californiae, but with incomplete cross-rings at the center; the other had anterior ⅔ boylii, posterior ⅓ californiae)

Certain comments on these results should be made. Both mothers were from San Diego County, California, but the exact localities of collection were not recorded. Both had mated in the wild; nothing is known concerning the fathers of the broods. The proportion of intergrades in these two broods (40 per cent) is very much higher than is usual amongst the San Diego County king snakes, where a record through ten years has shown that only about 3 per cent of the population are intergrades.

These hatched specimens are abnormal in other ways. One has only 39 caudals, while 45 is the lowest found in 233 other specimens from San Diego County. Another has 2 loreals on each side yet 2 loreals were not found in any of 230 other specimens. The percentage with no loreals was also higher than normal; this results from the fusing of the prefrontals and loreals. Two specimens have the internasals and prefrontals fused into one large scale on each side and in one instance these lap over to include the loreals. Another abnormality is the fact that the four *californiae* in the second brood have dark ventrums; this surface is usually light in San Diego County specimens. I have previously noted in the case of ovoviviparous snakes born in captivity, especially rattlers, that deviations from the normal are frequent in such broods. Whether this is the result of captivity. or whether abnormal individuals are born with equal frequency in the wild but fail to survive I cannot say.

It will be observed that all four intergrades in these two broods were males. This is characteristic of the intergrades for I find in my collection that out of 18 other intergrades from San Diego County 17 are males. No such predominance of males exists amongst normal individuals of the two phases, a count of 224 specimens from San Diego County producing this result:

	Californiae	Boylii
Males	53	66
Females	46	59
Percent males	54	53

This similarity in the sex distribution in the two phases indicates that pattern is in no way related to sexual dimorphism. On the other hand there is evidently a sex factor in the intergrades.

The above statistics refer to preserved specimens. The following figures are taken from a census of specimens observed or collected in San Diego County during the 12-year period 1924-1935 and is of interest in showing the zonal distribution of the two forms:

Zone	Californiae	Boylii	Ratio C/B
Coast	270	387	.70
Inland valleys and mesas	160	263	.61
Foothills	107	128	.84
Mountains	9	16	.56
Desert foothills	3	31	.10
Desert	0	5	.00
Total	549	830	.66

This indicates that the population capable of producing the *californiae* pattern is less tolerant of desert conditions—and probably mountain as well—than the general population of the subspecies. The same factors which cause the dimorphic form to have a limited range along the Pacific Coast seem to be effective in restricting it to certain zones in San Diego County. It is hardly possible that the time element is involved in this distribution, with a greater range to be expected in the future, in view of the occasional appearance of this phase in modified form as far north as Fresno and south to Cape San Lucas.

The total snakes recorded in San Diego County during the 12-year census has been 9868. The *californiae* snakes (including the intergrades) represent about 5.6 per cent of this population and *boylii* 8.4 per cent. The *californiae* phase comprises 37 per cent of the *getulus* king snake population, the intergrades 3 per cent, and *boylii* 60 per cent.

Prior to the hatching of these broods I had already been able to prove statistically (having at hand a greater quantity of material than had been available to previous workers) that there is no significant difference in the scale counts of the two phases. After all this is a sort of Scotch verdict, since even if differences of a significant level had been found, we might suspect their being correlated with pattern; that is, the result of the same genetic forces which may be presumed to cause the pattern divergence. Thus such differences, if found, would not have been a final proof of specific separation. Nor was the determination that there were no significant differences in the scale counts of the two phases proof of their unity, for this might have been a coincidence. But certainly it was interesting, and a hint of the final outcome shown by the broods, to find less difference between *californiae* and *boylii* in San Diego County than between *boylii* in San Diego County and *boylii* in central California.

The following are the statistics of the San Diego County specimens of the two phases:

	Californiae			Boylii			
	No. of Specs.	Mean	Coeff. of Var.	No. of Specs.	Mean	Coeff. of Var.	Signif. of Diff.
Dorsals	104	23.14±.04	2.74	123	23.29±.05	3.35	1.69
Ventrals, males	53	232.53±.39	1.82	66	233.23±.44	2.26	0.80
Ventrals, females	46	234.76±.48	2.04	59	235.36±.48	2.30	0.60
Caudals, males	53	56.21±.24	4.68	66	56.42±.26	5.58	0.41
Caudals, females	40	51.83±.31	5.70	60	52.08±.25	5.48	0.43
Supralabials	233	7.03±.01	2.62	259	7.01±.01	3.32	1.38
Infralabials	200	9.12±.03	5.97	211	9.12±.02	5.80	0.08

In explanation of the above table it should be stated that both means and probable errors have been abbreviated; in the computations of the significance they were carried to another decimal place. The coefficient of variation is given as a matter of interest; this is expressed in per cent.

It will be observed that in no case does the significance of the difference (difference of the means divided by the standard error of the difference) approach 3, which is usually taken as the lower limit of significance, as distinguished from the mere chances of sampling.

The extreme range of variation in these characters, while not as important as averages and coefficients of variations—in that they do not give a true picture of dispersion and result too often from aberrant individuals—are presented:

	Californiae	Boylii
Dorsals	21— 27	21— 27
Ventrals, males	224—244	220—247
Ventrals, females	220—246	222—249
Caudals, males	50— 61	49— 65
Caudals, females	46— 61	45— 61
Supralabials	6— 8	6— 8
Infralabials	8— 11	8— 11

Territorially the *californiae* phase has a much less extensive range than *boylii*. The latter is found at least from Yoncalla, Douglas Co., Oregon (Lat. 43½°N.) to Rosario, Lower California (Lat. 30° N.), and eastward into Nevada, Utah, and Arizona. *Californiae*, on the other hand, has not been collected north of Los Baños, Merced Co., (Lat. 37° N.) or south of a point 10 mi. N. of Ensenada, Lower California (Lat. 32° N.), and not eastward of California; and the range of the really typical representatives of this phase is even more restricted.

For while it has been said that the *californiae* phase manifests itself as far north as Merced County it should be understood that perfect examples of the striped type such as are found in San Diego County do not occur so far north; rather it may be stated that these

northern individuals are aberrant specimens of *boylii* with a tendency toward *californiae*. Most of those I have seen were rather less like a true *californiae* than are the so-called intergrades or mixtures from San Diego County. This county is undoubtedly the center of dispersion of the *californiae* phase, for not only are the most perfectly patterned examples found here but about 37 per cent of all the king snakes belong to this phase, while elsewhere they evidently comprise a much smaller proportion of the population, although no exact figures are available for these other territories. Further these northern representatives of *californiae* have a quality of pattern not met with amongst the more numerous *californiae* from San Diego County.

In order to make this clear it is necessary to describe briefly both phases as they occur in San Diego County. First let it be said that *californiae* and *boylii* in this territory do not differ essentially in head pattern; they are likewise similar in body color. The light marks in either may vary from white to buff, and the dark from red-brown through chocolate-brown almost to black. The color contrast is likely to be more accentuated in the young than in adults.

The San Diego representatives of *boylii* are similar to those found elsewhere in the range. The *boylii* pattern consists of light cross-rings separated by dark, there being from 22 to 40 of these rings on the body and 6 to 10 on the tail (fig. 1).* The relative widths of the two sets of rings vary considerably but usually the dark rings, where they cross the mid-dorsal line, are 3 or 4 times as wide as the light. Sometimes the light rings engage only a single scale but more often they cover about 2 scales, end to end, where they cross the middle of the back. Laterally, as the light rings approach the ventrum, they widen at the expense of the dark, so that as they cross the belly the widths of the light and dark rings are approximately equal, or the light may be wider.

Californiae, in its typical San Diegan form, has a light longitudinal stripe on the brown ground color from head to tail (fig. 2). This stripe usually engages the mid-dorsal row and half of the row on either side, thus being two rows wide. The lateral edges of the stripe are generally even, but the stripe may be imperfect in a variety of ways; it may be broken into a series of dashes or spots; it may vary in width or be laterally offset in sections by a scale-row or two. Breaks in the stripe on the tail are usual, the perfect stripe from head to tail-tip being rare indeed.

The lateral pattern is quite variable, but if we accept the specimens with the more perfect dorsal stripes as being those most truly representative of the *californiae* pattern we find the corresponding lateral pattern to consist of light lateral scale rows next the ventrals with increasing darkness as the dorsum is approached. This grad-

* While figs. 1 and 2 show the light scales edged with dark, and vice versa, this is done to outline the scales. Actually the scales are unicolor.

ual change is effected by a dark border around each scale, which border expands at the expense of the light center, continuously reducing the light spot. There is considerable variability in the row at which the light centers finally disappear from the scales but this usually occurs from the 4th to the 8th row above the ventrals, thus leaving from 6½ to 2½ solidly dark rows on either side of the dorsal stripe.

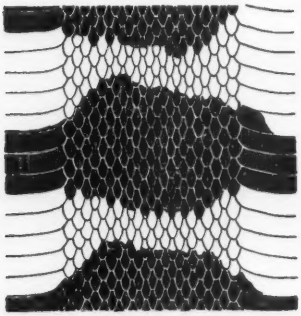

Fig. 1

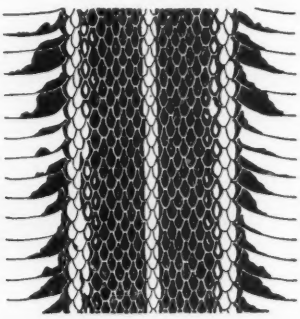

Fig. 2

Just as the mid-dorsal stripe is highly variable in quality so also is the coloration of the lateral areas, which, deviating from what seems to be the theoretical pattern, may be mottled, barred, or with longitudinal dashes in a variety of arrangements.

The belly of *californiae* is generally light, except that the outer edges of the ventrals are usually marked with dark blotches or irregular streaks. Only two specimens out of 60 had the ventral surface dark elsewhere than on the outer ends of the ventrals. But it is highly characteristic of *californiae* that the underside of the tail is always dark, there being no exception to this rule in 60 specimens checked. The transition from light to dark occurs quite sharply at the vent or slightly posterior thereto.

With this variability of both the *boylii* and *californiae* patterns it might be expected that the mixtures or intergrades would multiply the confusion, and such is the case, for we find in these all kinds of combinations of wide and narrow rings and stripes. But this we do note: First, there are more specimens with a predominance of *californiae* than vice versa; and, secondly, the *boylii* characteristics are more likely to appear at mid-body and the *californiae* at the extremities. In fact the tail is always *californiae* (dark) on the un-

derside; in pure *boylii* the light rings cross the underside of the tail.

Such is the pattern situation as it exists in San Diego County. As we go southward into Lower California there seems to be no change to the southern limit of the available specimens, for the most southerly known individual of *californiae* (from 10 mi. N. of Ensenada) retains all the characteristics of the San Diego County form.

North of the San Diegan area a rapid change is noted. I have seen typical *californiae* from only as far north as San Jacinto, Riverside Co., and Long Beach, Los Angeles Co.; and even from these areas aberrant specimens somewhat like the San Diegan intergrades are more frequently encountered than the pure *californiae* phase. Most of these have dark ventral surfaces.

Still further north, in the San Joaquin Valley, although the king snake population still retains the power to produce individuals differing from typical *boylii*, they are far from being typical *californiae*. In so far as these aberrant specimens tend toward any standard pattern it is a *boylii* dorsum, with the light rings widening suddenly on approaching the ventrals until they join and become lateral longitudinal bands. The entire ventral surface is quite dark, thus showing a more conspicuous deviation from typical *boylii* here than dorsally. Occasionally (as in CAS 41700 from Firebaugh, Fresno Co.,) a specimen is found with a section having a perfect mid-dorsal stripe, thus showing a relationship with typical *californiae*. Often these aberrant specimens have much less color contrast between the light and dark marks than is evident in *boylii* from the same territory; for while the latter is white or cream, and dark-brown, the former is often light-brown and dark-brown.

The two most northerly aberrant specimens are from Los Baños and Gadwell, Merced County, California. These are characterized by *boylii* dorsums, lateral light lines above the ventrals on each side (incomplete in the Gadwell specimen) and dark ventrums. Further to the north and in Nevada, Utah, and Arizona, so far as available material indicates, the king snakes have lost, or never attained, the ability to produce the *californiae* pattern.

We come now to the king snakes of the Cape Region of Lower California, a ringed form hitherto known as *Lampropeltis getulus conjuncta*, Cope, 1861, and a striped form, *Lampropeltis nitida*, Van Denburgh, 1895. Although *conjuncta* is rather weakly, if at all, differentiated from *boylii* the ranges as now known are separated by the distance between Rosario (Lat. 30° N.) and Comondu (Lat. 26° N.), or about 360 miles. As there has been considerable collecting in the intervening area it is somewhat doubtful whether there is an actual contact between the two groups.

Blanchard's criteria for the differentiation of *conjuncta* from *boylii* (1924, p. 24) fail to hold in several of the 10 new specimens of *conjuncta* lately available, as far as head markings are concerned. As to dark scale bases, these occur in *boylii* from various localities,

as, for instance, from the vicinity of Laguna Beach, California, and San Jose, northern Lower California, and are therefore not a distinctive *conjuncta* characteristic.

There remain the infralabials. We have the following statistics:

Infralabials (2 counts per specimen)	Boylii	Conjuncta
8	28	0
9	362	16
10	96	24
11	5	2
Total	483	42

That there is an average difference is evident, but it is equally clear that the infralabials will fail to identify many specimens. Nine specimens of *boylii* from near San Jose, Lower California, have infralabials equally divided between 9 and 10, and 10 are not infrequent at other points in the range. I think we must conclude that recognition of *conjuncta* as a valid subspecies is not warranted.

As to the relationship of *nitida* and *conjuncta*: this is not similar to that of *boylii* and *californiae* in San Diego County but on the contrary resembles that of *boylii* and the aberrant specimens in Fresno County. For *nitida* is dark, with little contrast between the light and dark areas, which are of two shades of brown rather than cream and brown, and the dorsal pattern is much like that of the specimens in Fresno County. Lateral stripes are usually present, sometimes with dorsal cross-rings, sometimes with short sections of a mid-dorsal line. The ventral surface is invariably dark. One specimen of *californiae* I have seen from central California, the exact point of collection being unknown, seems to be like *nitida* in every particular. Thus in the Cape region we have a duplication of the situation existing along the northern edge of the *californiae* range and, reasoning from analogy, it is probable that *nitida* is only an aberrant form, or pattern phase, of *conjuncta;* or, the latter being invalid, of *boylii*. Whether *catalinensis* will show the same relationship with a ringed snake as yet undiscovered on Santa Catalina Island remains to be demonstrated.

The power to produce a striped phase does not appear to be possessed by *L. g. yumensis;* at least among a number of recently available specimens of this snake no longitudinally striped specimens have come to light. But the new specimens do verify the validity of *yumensis;* for these, mostly from the immediate vicinity of Yuma, Arizona, are quite different from *boylii* and can be segregated therefrom at a glance. In fact in pattern they are nearer to *L. g. splendida*, for the color contrast is slight, the light rings are narrow and only the centers of the scales in these rings bear the light color.

There is no indication that *boylii* and *yumensis* intergrade across southern California, for there seems to be a gap formed by the Colorado Desert and no specimens of *yumensis* have been found west of

this desert. The specimen of *yumensis* reported by Van Denburgh from Coachella (1922, p. 760) is clearly *boylii* and the same is true of the specimens reported by Linsdale (1932, p. 378) from El Cajon Cañon, Lower California. It is to be presumed that *yumensis* will eventually get a foothold in the Imperial Valley, conditions being similar to those along the lower Colorado River where they thrive.

If *boylii* and *yumensis* intergrade it is not across the Salton-Imperial basin but via the Mojave desert and central Arizona to the vicinity of Phoenix, and thence south to the *yumensis* area between Yuma and Tucson. Intergradation between *splendida* and *yumensis* is much more evident; there is a gradual change from one to the other along the border between west Texas and Yuma.

The nomenclatorial result of this combination of *californiae* and *boylii* is rather unfortunate in that *californiae* takes precedence as the older name (1835) over *boylii* (1853) and thus requires a change of name for the Pacific King Snake in northern California, southern Oregon, Nevada, Utah, and Arizona where the *californiae* phase does not occur and where the name therefore has hitherto been unknown. Yet the rules of nomenclature seem to leave no alternative, since no provision is made for color or pattern phases of a single subspecies. There is no doubt as to the snake which Blainville originally described, since his description and figures (p. 292, pl. 27) are clear and it is known that Dr. P. E. Botta, who collected the type, was in the vicinity of San Diego in April, 1827 (Palmer, 1917, p. 159). Jan's figure (Jan, 14e livr., pl. 5, fig. 3), said to be the same specimen, is a fine representation of the striped phase as we know it in the vicinity of San Diego.

In the case of the Cape San Lucas subspecies the name of the ringed phase *conjuncta* (1861) takes precedence over *nitida* (1895), the striped phase, and would be used if the Cape form were valid.

SUMMARY AND CONCLUSIONS

Lampropeltis californiae (Blainville), 1835, a striped king snake of southern California and northern Lower California is shown to be a pattern phase, rather than specifically distinct from the common ringed king snake of the Pacific Coast hitherto known as *Lampropeltis getulus boylii* (Baird and Girard), 1853. The combined form must be known as *Lampropeltis getulus californiae*. The proof of identity was secured by hatching broods which contained both forms. By analogy *Lampropeltis nitida* of the Cape region of Lower California is thought to be a pattern and color phase of *Lampropeltis getulus conjuncta*, but this in turn is of doubtful validity so that all of these king snakes should be referred to as *L. g. californiae*.

ACKNOWLEDGMENTS

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Notes on Brazilian Amphisbaenians

by KARL P. SCHMIDT
Field Museum of Natural History

An extensive collection of Brazilian amphibians and reptiles collected by the Hopkins-Branner Brazilian Expedition of 1911 was loaned by the California Academy of Sciences to Field Museum of Natural History for comparative study with other Brazilian material. The fact that relatively few collections have been made in northeastern Brazil since the explorations of Spix and Martius, and that the bulk of the Hopkins-Branner collection comes from the States of Rio Grande do Norte, Parahyba, and Ceará, lends especial interest to this material. The collection is due to the efforts of Dr. Harold Heath, of Stanford University, Dr. Fred Baker of Point Loma, California, and Dr. William M. Mann, Director of the United States National Zoological Park.

The importance of this collection may be judged from the fact that the twenty-four specimens of amphisbaenians collected include no less than eight species. Since four of these appear to be new, I have drawn up the following account of them for separate publication. It is intended to report at length on the collection as a whole.

Amphisbaena fuliginosa Linnaeus.

Amphisbaena fuliginosa Linnaeus, 1758, Syst. Nat., p. 229, (type locality "America")

A single specimen No. 49818, from Manaos, Amazonas. Body and tail annuli 210+26; preanal pores 8; segments above and below the lateral line 22+22; coloration of the usual mottled type, dark predominant above and light beneath; head light to the second complete annulus.

Amphisbaena alba Linnaeus.

Amphisbaena alba Linnaeus, 1758, Syst. Nat., p. 229, (type locality "America").

Two specimens, Nos. 49825-6, from Manaos, Amazonas; one, No. 49535 from Papary Lake, and a fourth, No. 49603 from Extremoz, Rio Grande do Norte. The characters of these specimens are as follows:

Museum No.	49535	49603	49825	49826
Annuli on body and tail	223+19	235+21	235+19	236+19
Segments at mid-body (d+v)	35+38	32+41	36+43	36+41
Pores	8	9	9	8

I find no distinctive difference between the two specimens from northeastern Brazil and those from Manaos.

Amphisbaena subocularis Peters.

Amphisbaena subocularis Peters, Monatsber. Akad. Sci. Berlin, 1878, p. 779, fig. 2. (Type locality, Pernambuco, Pernambuco, Brazil).

Five specimens from Lake Papary, Rio Grande do Norte, Nos.

49862, 49864-5, 49867-8, have been compared with a specimen in Field Museum, No. 5660, from Queimados, Bahia, collected by R. H. Becker in 1913. Amaral (1935, Mem. Inst. Butantan, p. 232) suggests that the presence or absence of a subocular and preocular is an adventitious character of the amphisbaenians of this region, and that *subocularis* may be referrable to the synonymy of *pretrei*, which lacks these scutes. The present series tends to support this suggestion, but I have retained *subocularis* provisionally until more detailed studies can be made. The taxonomy of the Amphisbaenidae in general is obviously much in need of an evaluation of the species characters by means of a comprehensive review.

The characters of the specimens examined are as follows:

	C.A.S.	C.A.S.	C.A.S.	C.A.S.	C.A.S.	F.M.N.H.
Museum No.	49862	49864	49865	49867	49868	5660
Annuli on body and tail	238+30	240+29	244+29	234+29	234+29	235+32
Segments, mid-body (d+v)	24+24	26+25	24+24	23+22	23+26	24+25
Pores	8	6	6	6	6	6
Preoculars	0-0	1-1	0-0	0-0	0-0	1-1
Suboculars	1-0	1-1	1-1	1-1	1-1	1-1

Amphisbaena brachyura Amaral.

Amphisbaena brachyura Amaral, 1932, Mem. Inst. Butantan, 7, p. 55. (type locality Maceio, Alagoas, Brazil).

Two specimens, C. A. S. No. 49601-2, from Extremoz, Rio Grande do Norte, are referred with some hesitation here; they agree with the recently described *brachyura* in shortness of tail, though the tails are scarred at the tip and do not appear to be complete. The present specimens differ from the series of *A. subocularis* in having well-developed occipitals, in having fewer segments in an annulus, and in having a higher number of annuli on the body. This last character in turn fails to agree with *brachyura;* but on the data available this is the best disposition of these two specimens, pending further accumulation of material. The segments in the fifteenth annulus behind the head number 33 and 30 respectively, as compared with 38 to 44 in *subocularis*. The characters of the specimens are:

Museum No.	49601	49602
Annuli on body and tail	263+11?	247+11?
Segments at mid-body (d+v)	22+22	20+22
Pores	6	6
Preoculars	0-0	0-0
Suboculars	0-0	0-0

AMPHISBAENA HEATHI, sp. nov.

Type.—California Academy of Sciences No. 49374, from Baixa Verde, Rio Grande do Norte.

Diagnosis.—Allied to *Amphisbaena vermicularis* and *A. darwini;* distinguished from the former by its lower number of segments in an annulus, and larger prefrontals, and from the latter by its higher number of caudal annuli and extremely different chin shields.

Description of type.—Body relatively slender, its diameter contained 41 times in the length; annuli 193+32; segments in an annulus

at mid-body 12 above and 20 below the lateral line; lateral line distinct except for the anterior fourth of the body; 28 segments in the fifteenth annulus; snout rounded, projecting, rostral slightly visible from above; nasal suture half that of the prefrontals; prefrontals large, their suture longer than that between the frontals, occipitals large; eye well visible, the ocular in contact with the second and third labials, followed by two temporals; upper labials 3-3, lower labials 3-3, the first pair in contact behind the mental, three small subequal anterior chin shields; six anal segments; four preanal pores:

Brownish yellow above, lighter beneath.

Length 145, tail 21, diameter 3.5, length of head to first annulus 5.

Notes on paratypes.—The single paratype, C. A. S. No. 49424, from Ceara Mirim, Rio Grande do Norte, agrees closely with the type in characters of the head scales and otherwise. The annuli number 186-11; the segments are 12 dorsal and 20 ventral; no pores are discernible. It might be suspected that the variation in length of tail in such forms as *A. fuliginosa, A. darwini,* and the present species, represents a sex character; but I am unable to verify this in *A. fuliginosa,* and have not dissected the specimens of *A. heathi.* It seems curious that the tail should be mutilated so that the tail-lengths fall into two non-overlapping groups.

AMPHISBAENA SPIXI, sp. nov.

Type.—California Academy of Sciences No. 49423, from Ceara Mirim, Rio Grande do Norte.

Diagnosis.—Closely allied to *Amphisbaena steindachneri* of Matto Grosso, from which it is distinguished mainly by the larger number of segments in the annuli, 20 above and 20 below the lateral line as compared with 16-12 in *steindachneri;* 33 segments in the fifteenth annulus behind the head. The caudal annuli are also more numerous in the present form. *Amphisbaena mattogrossensis* with similar head shields has eight pores instead of four.

Description of type.—Body somewhat stocky, the diameter contained 38 times in the length; annuli 238+30; segments in an annulus at midbody 20 above and 20 below the lateral line; lateral line distinct except on the most anterior annuli; snout rounded, little projecting, rostral slightly visible from above; nasal suture nearly as long as that between the prefrontals, which in turn equals that between the frontals; occipitals not enlarged; eye well visible, the ocular in contact with the second and third labials, followed by two temporals; upper labials 4-4, lower labials 3-3, fourth upper labial small; mental large, quadrangular, followed by a large five-sided median chin-shield; six anal segments; four preanal pores.

Brown above with light sutures between the segments; yellowish below, the segments with a darker anterior border.

PLATE III

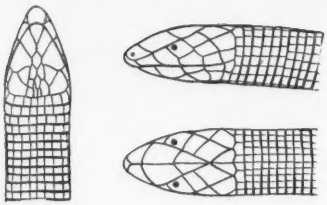

Fig. 1
Amphisbaena heathi

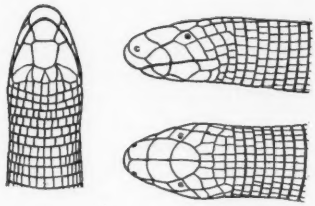

Fig. 2
Amphisbeana spixi

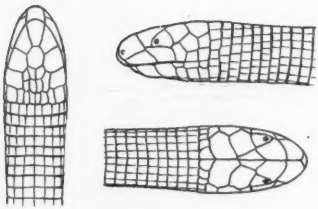

Fig. 3
Amphisbeana slevini

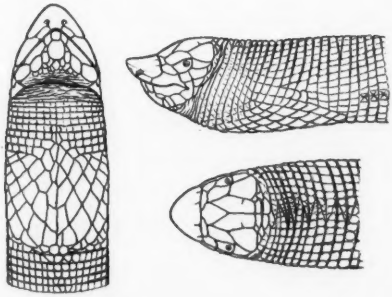

Fig. 4
Leposternon polystigoides

NEW BRAZILIAN AMPHISBAENIANS

Length 213, tail 26, diameter 5.5, length of head to first annulus 6.

Notes on paratypes.—Two additional specimens, C. A. S. Nos. 49421-22, agree excellently with the type; their annuli number respectively 236+8 and 243+30; the occipitals are distinctly enlarged in No. 49422. I associate here provisionally C. A. S. No. 49896, which bears only the locality Brazil, collected by Baker and Mann. This specimen has the head shields similarly arranged, has 20+20 segments, and four preanal pores; but the number of annuli, 254+29, is higher than in the Ceara Mirim series.

AMPHISBAENA SLEVINI, sp. nov.

Type.—California Academy of Sciences No. 49809, collected at Manaos, Amazonas.

Diagnosis.—Closely allied to *Amphisbaena slateri* Boulenger, from the Peruvian Amazon, from which it is distinguished mainly by the greater size of the nasals in proportion to the prefrontals, the suture between nasals, prefrontals, frontals and occipitals being subequal in the present form.

Description of type.—Diameter of body contained 35 times in the length; annuli 206-7, segments in an annulus at midbody 12 above and 10 below the lateral line; a well marked median dorsal groove, similar to the lateral line, extends the whole length of the body and tail; lateral line extended nearly to the head; snout rounded, a little projecting; rostral barely visible from above; nasal suture equal to that between the prefrontals; this equal to that between the frontals, and likewise to the occipital suture; occipitals very large, wider than long; eye well visible at the anterior corner of the ocular; ocular in contact with the second and third labial; a single large postocular behind each ocular, in contact with the third labials; upper labials 3-3, lower labials 3-3; mental elongate, longer than the median chin shield; eight anal segments, four preanal pores.

Uniform light brown above and below.

Length 107, tail 4, diameter 3, length of head to first annulus 4.0.

Remarks.—This specimen differs from the single known specimen of *slateri* in having only three upper labials, the mental and chin shield not fused, and in the very different length of the suture between the nasals.

LEPOSTERNON POLYSTEGOIDES, sp. nov.

Type.—California Academy of Sciences No. 49866, from Lake Papary, Rio Grande do Norte.

Diagnosis.—Closely allied to *Leposternon polystegum*, from which it is distinguished by a slightly lower number of annuli, and of segments in an annulus, and by the invariable contact of the rostral with the frontal.

Description of type.—Body stocky, the diameter contained 34 times in the total length; rostral wih a sharp horizontal edge, the nostrils inferior, above the suture with the first labial; frontal subtriangular, nearly as wide as long, the median third of its anterior border in contact with the rostral; a pair of small prefrontals; parietals elongate, with the suggestion of a transverse groove; a pair of small occipitals; ocular nearly square; a large temporal shield; upper labials 2-2; lower labials 2-2; mental small; a large median chin shield, with a series of three on each side bordering the large lower labial; a pronounced gular groove; pectoral shields numerous, in oblique rows; dorsal, lateral, and ventral grooves well marked; 275+15 annuli; segments behind pectorals, at midbody, and anterior to anus: 24-24-24 above, and 16-22-24 below.

Uniform pale brownish yellow above and below.

Total length 344, tail 19, diameter 10, length of shielded part of head 10.

Notes on paratypes.—The four paratypes agree closely with the specimen described above. In no case is there a contact of the prefrontals, excluding the frontal from contact with the rostral; the number of segments in an annulus above and below the lateral line varies by one to three segments from the formula for the type, and varies in fact by at least one scale in each quadrant from place to place on the individual specimens. The scale counts of these specimens are as follows:

Museum No.	49375	49533	49534	49863	49866 (type)
Annuli on body and tail	269+16	274+15	270+15	265+15	275+15
Segments at mid-body (d+v)	24+22	24+22	24+22	24+22	24+22

The whole variation discoverable in the number of segments in the annuli anteriorly, at mid-body, and in front of the anus may be summarized for the segments above the lateral line as: 21-24—23-25—24-26, and below as: 14-18—21-22—22-25. By searching for a suitable annulus, however, the count 24+22 at mid-body could be obtained in every specimen.